

Amendments to the Specification:

Please replace the paragraph beginning at page 1, line 7, with the following rewritten paragraph:

-- No other applications relate. --

Please replace the paragraph beginning at page 4, line 12, with the following rewritten paragraph:

-- In order to detect and capture the image of the powder it has to be made highly visible. This is achieved by a special detector. Typically, the detector will contain a shroud blocking ambient light or other electromagnetic radiation. Within the detector, a special environment is set up to make the powder highly visible relative to the background. By way of example, the taggant can be a fluorescent powder and the special environment making it highly visible is Ultra Violet (UV) light. Such fluorescent powders are widely used in fluorescent inks and markers, are readily available, stable and inexpensive. Particle size should be in the ~~5-50 μ m~~ ~~5-50 μ m~~ range. If a higher level of security is required, the taggant can be a completely optically and chemically inert powder with thermal properties different from those of the background. --

Please replace the paragraph beginning at page 4, line 23, with the following rewritten paragraph:

-- When exposed to a pulse of intense light (at almost any part of the spectrum) and viewed with a camera sensitive to the ~~5 μ m-10 μ m~~ ~~5 μ m – 10 μ m~~ range of the IR spectrum, the taggant particles will appear brighter or darker than the background, depending on their thermal properties. The light pulse should have duration from 0.1mS to 50mS, preferable 1-5mS, and the viewing should be within a few mS of the pulse. The camera used for viewing can be of the microbolometer type. The light source can be a standard camera electronic flash unit. By way of example, the taggant can be aluminum or stainless steel powder, glass or polystyrene microspheres, or alumina (Al_2O_3) powder. Materials heating up less than the background will show up as dark dots, materials heating up more will show up as light dots. Particle size should be in the ~~20-50 μ m~~ ~~20-50 μ m~~ range.

A very similar system used to detect small defects in copper traces is disclosed in US patent 6,340,817 (having the same inventor and assignee as the current application). --

Please replace the paragraph beginning at page 5, line 10, with the following rewritten paragraph:

-- Further details on the construction of the detector are given in Fig 2. An item 1, such as a printed label, is tagged by mixing taggant particles 3 in the substrate material or ink in order to permanently anchor the taggant to the substrate. Concentration can be as low as a few ~~parts~~ parts per million by weight. The detector 4 comprises of a camera 6, focused on the surface of item 1 using lens [[5]] 7. An optical filter 13 blocks the excitation light, generated by pulsed source 8, from the camera. A shroud 5 blocks ambient light. The output of the camera 101 (typically NTSC video) is converted to a binary image using comparator 9. The threshold of comparator [[5]] 9 is automatically set by processing unit 11 via feedback 10 to generate a fixed number of detected taggant particles (more details on this are given later). The output is fed as serial data stream 12, giving the coordinates of the taggant particles. Obviously, the data can be encrypted, if desired, for even greater security. For UV fluorescence, light source 8 is a high power UV LEDs (Nichia part # NCCU001E, 10 LEDs used in parallel) and [[F]]filter 13 is an interference filter with a bandwidth and center wavelength matched to the fluorescent powder selected. Filters 14 block any light above a wavelength of ~~0.4um~~ 0.4 μ m. For best results, yellow or red fluorescent powders are used, as many substrates have blue fluorescence used as a whitener (the colors mentioned refer to the emitted light, not to the color of the powder in the unexcited state, which is typically white). For the thermal taggants the light sources 8 are a camera flash unit and filter 13 is a long pass filter blocking any light below ~~3um~~ 3 μ m. Filter 14 is a short pass filter blocking any light above ~~2um~~ 2 μ m (in order to avoid blinding of the camera by the flash units). The camera is of the microbolometer type. By way of example, good results were obtained with an AGEMA microbolometer camera model 570 and a close-up lens. A second light source, 8', may be required if the registration mark (item 2 in Fig 1) is not clearly visible under the illumination of filtered light source 8. --

Please replace the paragraph beginning at page 6, line 9, with the following rewritten paragraph:

-- The steps ~~needs~~ needed to practice the invention are shown in Fig 1. Fig 1-a shows an item 1, by the way of example a document or a security label. A reference mark 2 is selected to register the taggant image. The edges of the item can also be used as a reference, when nothing is printed on it. The reference mark can be a line, a company logo, a frame etc. In the normal mode the taggant is not visible. While item 1 was made (or printed) taggant 3 was added and the taggant distribution is shown in Fig 1-b. Fig 1-b visualized the distribution, which is not normally visible. The taggant 3 can also be added selectively, for example by mixing it only with a particular ink or varnish, as shown in Fig 1-c. When the detector 4 is placed over item 1 it does not need to be aligned with it, as shown in Fig 1-d., as long as it covers the area of interest. The camera in the detector sees the taggant 3 in the area of interest, frame 2, as shown in Fig 1-e. The image appears rotated, as the detector was not aligned with item 1. The processor 11 in Fig 2 includes software to recognize the reference mark 2 and rotate the image to align it with the horizontal and vertical axis (or any selected reference axis). The subsystem comprising the camera, lens, electronics and image registration and rotation software is available as a standard package from suppliers of machine vision systems. By the way of example, a compact package in the InSight product line made by Cognex (Natick, ~~MA~~ Mass). As explained earlier, the processor output can set the threshold of the comparator 9 in Fig 2 to always have the same number of taggant particles detected, in order to simplify the data base. Since the taggant particles have a distribution of sizes, changing the threshold changes the number of particles whose signal will exceed the threshold. A fixed threshold, variable particle count can also be used. The processed image appears in Fig 1-f. --

Please replace the paragraph beginning at page 7, line 19, with the following rewritten paragraph:

-- The authentication process is shown schematically in Fig 3. When each item is recorded into the database, it is read by the detector shown in Fig 2 and the output data 12, which is 12 bytes in this example, is stored in the database 23 in Fig 3. Since the images are random, they can be stored sequentially in the database; that

is, there is no preferred order. For large databases, special algorithms can be used to “classify” the images for faster retrieval. When an item has to be authenticated (such as a passport at the border or a label on a product), the item is read by the detector and the processed taggant image (Fig 1-f) is sent as data 12 from the detector to the verification unit 102 shown in Fig 3. There the data 12 is stored in a register 18 and is compared to all the images or data 15 in the database 23 until a match is found. The images are read out 16 from database 23 into a register 17, and comparators 19 check for matches. In this example there are six comparators for the six taggant particles. The output of the comparators (COM1, COM2.....COM6) are fed to a logic circuit 20 which is programmed with the number of matches which have to be reached before a “Pass” signal 21 or “Fail” signal 22 is generated. For six particles, a good threshold is four or five matches. Requiring six matches will cause problems in cases that a taggant particle was obstructed, missing or not detected. The “Pass” signal can be sent back from the verification unit to the detector. The data links can be over phone lines, wireless, Internet or any other means. The required data rate is very low: to verify 100 items per second the data rate is only $100 \times 12 \text{ bytes} = 1200 \text{ Bytes/sec}$ in this example. For large databases and very rapid identification, at least part of database 23 has to be in Random Access Memory (RAM) as images have to be compared quickly. For increased throughput, the database can have multiple parallel ports 24, each connected to a different section, and all sections checked in parallel. This requires only the duplication of items 17,18, 19, 20, which are low cost items. --